DEVICE FOR OPENING AND DISTRIBUTING A BUNDLE OF FILAMENTS DURING THE PRODUCTION OF A NONWOVEN TEXTILE WEB

TECHNICAL FIELD

The invention relates to an improvement made to the installations for making a nonwoven textile web, which is commonly referred to by the generic name of spunbond and which is formed by continuous synthetic filaments.

It concerns more particularly, an improvement made to the means for distributing the extruded filaments, after drawing, over a movable transporting belt, over which they are randomly distributed so as to form a regular web, with a weight and thickness which can be adjusted according to the applications.

PRIOR ART

The production of nonwoven webs of the spunbond type goes back decades and consist, generally speaking:

- in extruding a melted organic polymer through a spinneret perforated with holes, so as to form a bundle or curtain of filaments;
- then, in orienting the extruded filaments by drawing by means of one or more fluid jets, in particular, compressed air devices; and, finally
- in receiving the bundle of filaments in the form of a web on a movable transporting belt, which is generally subjected to a suction source and the speed of which is adjusted according to the characteristics of the web, in particular thickness, which it is desired to achieve.

After production, the web is consolidated, for example, by performing a sizing or calendering, preferably hot calendering, so that the elementary filaments are joined to one another.

Other consolidation treatments may be performed, where appropriate, such as, for example, a needling treatment (conventional or by fluid jets), and/or the deposition of a bonding substance on the surface or in the interior of the web.

Generally speaking, the installations used to produce such products comprise:

- at lease one extruder for a melted organic polymer feeding a spinneret for producing a curtain of filaments;
- a cooling zone for bringing about at least surface solidification of the said extruded filaments;
- a suction device in the form of a narrow chamber of rectangular cross-section, inside which the curtain of filaments is subjected to the action of high-speed air streams causing the filaments to be drawn, which assembly will be referred to hereinbelow by the term "drawing slot"; and
- a means for deflecting and slowing down the air flow at the outlet of the drawing slot and for distributing the filaments randomly over a receiving belt.

In such installations, the filaments emerge at the outlet of the drawing slot in the form of a bundle of filaments grouped together in the mid-plane of the slot.

These filaments are ejected at very high speed from the drawing slot, a speed which can reach 3000 m/min or more depending on the state.

In order to obtain a nonwoven web as homogeneous as possible on the receiving belt onto which the filaments leaving the drawing slot are projected, it is necessary not only to separate the filaments from one another, but also to slow down their speed before their impact with

the belt, in order to limit the uncontrollable rebound phenomena which generate a heterogeneous formation of the sheet.

To ensure such a break-up and distribution of the curtain of extruded filaments, various techniques have been proposed to date.

The oldest technique, which emerges in particular from the patent GB-A 932,482, and from the patent US 3,967,118, consists in electrostatically charging the filaments, which tends to push them away from one another (corona effect).

This technology makes it possible to improve the formation of the sheet when the filaments are ejected at relatively low speed from the drawing slot. Consequently, the so-called grouping-together phenomena of the filaments are dominant over those of the rebounding of the filaments on the belt.

This is the case, in particular, when the sheet consists of relatively coarse filaments, that is to say, with a count greater than or equal to 2.2 dtex per filament. Such filaments are generally produced with speeds at the drawing-slot outlet of less than 3000 m/min.

In order to reduce the speed without adding an additional element, it is necessary in this case for the end of the drawing slot on which the electrostatic device is fixed to be situated at a relatively large distance from the receiving belt, of the order of 500 mm or more. This enables the frictional forces of the filaments in the air to slow down their speed, thereby limiting the rebound phenomena and thus improving the formation of the sheet.

This device is not entirely satisfactory, since no control of the speed is possible and the filaments are

also subjected to all the outside air currents, thereby disrupting the sheet and creating defects.

Finally, the simple friction of the filaments in the air over such a short distance does not permit sufficient slowing-down of their speed to enable the rebound phenomena of the filaments on the belt to be attenuated sufficiently.

Consequently, it has been proposed, as emerges from the patent US 3,286,896, to fit to the end of the drawing slot (see Figs. 7 and 8) a deflecting system to ensure a better distribution and opening of the bundles of filaments produced.

However, since this solution does not give complete satisfaction, it has been proposed, as emerges from the patent US 3,325,906, to associate with the divergent nozzle at the drawing-slot outlet, an assembly for insufflating air on each side of this divergent nozzle. This creates a negative pressure in the vicinity of the walls, thus attracting the fibers towards the walls, thereby tending to open the bundle of filaments and also slow down the speed thereof.

Such a device, which is satisfactory in theory, nevertheless has a limited effectiveness. This is true since it is mainly the fibers situated on each side of the bundle which are thus "spread", those grouped together at the center of the said bundle being extremely difficult to separate from one another.

SUMMARY OF THE INVENTION

Now, it has been found, and this forms the subject of the invention, that it was possible to achieve not only a perfect opening of the bundle of extruded filaments at the outlet of the drawing slot, but also a very homogeneous distribution over the receiving belt. This is achieved, one the one hand, by separating the

assembly for opening the bundle of filaments from the actual drawing slot, and on the other hand, and above all, by designing this opening assembly such that it combines both the advantages of the techniques of electrostatically charging the filaments and the techniques of opening the bundle by slowing down the air speed at the drawing-slot outlet, and thus the speed of the filaments before reception on the receiving belt.

Generally speaking, the invention thus relates to a device for opening and distributing a bundle of filaments during the production of a nonwoven textile web. This is achieved according to the technique which consists:

- in extruding a melted organic polymer through a spinneret perforated with holes, so as to form a bundle or curtain of filaments;
- then, in orienting the extruded filaments by drawings by means of one or more fluid jet devices; and, finally
- in receiving the bundle of filaments in the form of a web on a movable transporting belt below which is arranged a suction source.

The device for opening and distributing the bundle of filaments according to the invention consists of an assembly arranged downstream of the outlet of the drawing assembly and separated therefrom. This assembly is arranged close to the outlet of the drawing slot, a diffuser comprising an inlet zone in the form of a convergent nozzle extending over the entire width of the installation opposite the outlet of the drawing slot for producing the web, extended by a divergent nozzle. The assembly is associated with a rail that electrostatically charges the filaments before they are received on the receiving belt.

According to one embodiment, the divergent zone of the diffuser comprises two walls and two lateral slots

situated at the top of the diffuser on each side thereof. This permits either an indraught of air from outside due to the venturi effect, or, where appropriate, an injection of air under a pressure less than one bar and advantageously between 0.4 and 0.8 bar, bringing about an air flow against the walls of the diffuser.

The above diffuser makes it possible to precisely adjust the width of the bundle of fibers and also the impact speed of the filaments on the receiving belt. The electrostatic charging assembly being able to be situated, where appropriate, downstream of the diffuser assembly, but preferably being integrated inside the latter, thereby accentuating the opening of the bundle of filaments.

Advantageously and in practice:

- the diffuser comprises an inlet zone in the form of a convergent nozzle connected to the two walls of the divergent zone by a rectilinear slot, the rail electrostatically charging the filaments being mounted at the level of the rectilinear slot immediately upstream of the divergent zone;
- the distance of the diffuser from the receiving belt is adjustable, in order to minimize the influence of the outside air currents on the bundle of fibers;
- the pressure of the air which flows in the diffuser against the walls thereof and the adjustment of the voltage applied in the electrostatic rail makes it possible to adapt very precisely the conditions of the formation of the sheet according to the speed of the filaments at the drawing-slot outlet, thereby making particularly such a device suitable for the formation of a sheet consisting of low-

denier filaments, and also for production installations working at high speed; and, finally

- the separation of the actual drawing system and that for distributing the curtain of filaments allows a possibility of adjusting the count of the filaments without changing the appearance of the sheet and vice versa.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention and the advantages which result from it will be better understood through the exemplary embodiment which is given by way of guidance but without limitation, and which is illustrated by the attached diagrams, in which:

FIG. 1 is a general view of an installation for producing a nonwoven web of the spunbond type;

FIG. 2 is a detail view showing schematically the structure and functioning of an assembly for the opening of the bundle of filaments which is formed and its deposition on the receiving belt;

FIG. 3 illustrates a modified embodiment according to the invention in which the electrostatic charging of the filaments is obtained by way of a rail integrated inside the diffuser, and wherein it is possible for the flow of air inside the latter against the walls to be produced either by natural indraught of the outside air, or by a system of injection under low pressure less than one bar.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring to the attached figures, the device according to the invention is intended for use on a line for producing a nonwoven textile web consisting of continuous synthetic filaments.

Generally speaking, as can be seen from FIG. 1, such an installation is composed essentially of at least one extruder, designated by the general reference 1, which feeds synthetic polymer, such as polyamide, polyethylene, polyester, etc., to a spinneret 2 for the formation of a curtain of filaments 3.

From a practical point of view, by way of guidance, the spinneret consists of a plate each containing a multitude of holes, for example 5000 per meter of width and having a diameter depending on the extruded filaments, for example, 0.5 mm. These holes are distributed over a plurality of parallel rows, for example over eighteen rows, and over a width at the spinneret outlet of 140 mm.

At the outlet of this spinneret is arranged the cooling assembly 4 for adjusting the temperature of the filaments depending on the polymers. For example, the cooling assembly may comprise a plurality of successive zones 4a, 4b and 4c, for subjecting the curtain of filaments 3 to traversing air flows. The speed and temperature of the traversing air flows may be adjusted.

By way of illustration, the length of the cooling zone is of the order of 1200 mm. The temperature and speed if filaments in each of the zones decreases from the first zone 4a to the third zone 4c.

Downstream of the cooling zone 4c is arranged the actual drawing assembly 5. The drawing assembly 5 is in the form of a closed enclosure having a slot "F" into which air is injected under pressure, for example, of the order of 0.5 bar.

Such a drawing system makes it possible to bring about the suction of the curtain of filaments and its entrainment by high-speed air streams for effecting the drawing.

At the outlet of the drawing assembly 5, the bundle of filaments 3 is projected onto the receiving belt 7 by way of an opening and distributing assembly 6. The assembly 6 forms the subject of the invention, the two embodiments of which can be seen in FIGS. 2 and 3. The assembly 6 causes the air flow leaving the slot "F" to deviate and slow down, thus bringing about the opening of the bundle of filaments.

In the first embodiment illustrated in FIG. 2, the assembly 6 comprises, close to the outlet of the drawing slot "F" of the assembly 5, on the one hand, a diffuser designated by the general reference 10, and a downstream rail 11. The diffuser 10 consists essentially of a divergent nozzle which extends over the entire width of the web being produced. On the other hand, downstream of this opening assembly, a rail 11 arranged to electrostatically charge the filaments at the outlet of the assembly 10, and thereby ring about an opening at the heart of the bundle of filaments before they are deposited on the receiving belt 7.

In this embodiment, the diffuser assembly 10 is composed essentially of a chamber 12 having an inner slot 13. The slot 13 is in the form of a convergent/divergent nozzle extending over the entire width of the installation opposite the outlet of the drawing slot "F" of the assembly 5.

Opening into this slot 13, close to the lower part of the divergent zone, are two laterally arranged symmetrical slots 14. These symmetrical slots 14 may be either connected to a source of compressed air injected under a pressure less than 1 bar and advantageously of the order of 0.4 bar, or be simply open to the outside air.

The divergent zone is, in this embodiment, extended by two walls 15 which are likewise divergent.

Arranged immediately downstream of this diffuser assembly, or where appropriate integrated inside the latter, is a conventional rail 11 for electrostatically charging the filaments. This makes it possible to intensify the opening of the bundle. The rail 11 is a conventional rail, for example of the type described in US 3,967,118.

FIG. 3 illustrates a second embodiment of the assembly 6 for opening and distributing a bundle of filaments in the form of a web produced in accordance with the invention.

In this variant, using the same references as those employed to describe the example illustrated by FIG. 2, the assembly 6 for opening and distributing the bundle of filaments 3 is, as before, separated from the drawing assembly 5.

This embodiment also comprises an inlet zone 13 in the form of a convergent nozzle extending opposite the outlet of the drawing slot "F". This inlet zone 13 in the form of a convergent nozzle is connected to the two walls 15 of the divergent zone by a rectilinear slot 20.

The rail 11 for electrostatically charging the filaments is, in this embodiment, integrated inside the diffuser 10 at the end of the rectilinear slot 20 immediately upstream of the divergent zone 15.

An indraught of air coming from outside owing to the venturi effect is produced through the two adjacent lateral slots formed by the lower face of the drawing assembly 5 and the upper face of the opening and distributing assembly 6.

An air flow thus arises along the walls 20, 15 over the opening and distributing assembly.

Where appropriate, as in the embodiment described in conjunction with FIG. 2, an injection of air under low pressure, less than 1 bar, could be produced at the two

lateral slots formed between the drawing assembly 5 and the opening and distributing assembly 6.

It was found that with such a device not only was a perfect opening of the bundle of filaments obtained, but that, furthermore, the reception of the belt 7 was very regular and led to a very homogeneous nonwoven web being obtained.

Of course, the invention is not limited to such an embodiment, but covers any variants thereof realized in the same spirit.